Designing and implementing an smart monitoring and management system of environmental and electrical conditions of server rooms

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Abstract

Contents

Chapter 1

Introduction

1.1 Backgrounds

Server rooms are a critical component of today's technology-driven world: with the growing reliance on and need for technological devices, ensuring that server rooms function properly has become an essential part of our daily lives. Server rooms are important to an organization because they contain infrastructure and critical equipment. Monitoring various parameters such as temperature, humidity, electricity and others helps ensure that the system is running smoothly. The first step in monitoring server rooms is to understand the different parameters that need to be monitored. The following is a list of common parameters that should be monitored in server rooms :

- Temperature

  Server room temperature should be maintained at a stable, suitable level to ensure the proper functioning of equipment. The recommended range of temperatures is between 18°C and 27°C. [1]

  Too high temperature: If the temperature inside a server room rises above the recommended range, it can cause several problems. High temperatures can make equipment operate less efficiently and potentially fail altogether. High temperatures can also decrease the life expectancy of electronic devices and increase the chance that stored data will be corrupted. [2]

  Too low temperature: If the temperature in a server room is allowed to fall below the recommended range, it can cause several issues. The cold air can lead to condensation—which leads directly to corrosion and equipment damage. In addition, low temperatures can decrease the efficiency of equipment and make it more likely to fail. [2]

- Humidity

  On the other hand, High humidity levels can lead to condensation, which causes corrosion of the equipment and short circuits. High humidity levels can also create conditions that are conducive to the growth of mold and other microorganisms, which in turn damage equipment and affect indoor air quality. [3]

- Dust

  Dust accumulation in a server room can degrade the performance and lifespan of equipment. Dust can block air vents, causing overheating, and it also attracts moisture leading to corrosion or other problems. So monitoring the levels of dust in a server room can help identifying and addressing potential problems.

  The suitable range for dust density in a server room is around 0 to 3mg/m3.

- Water Leakage

  Serious consequences can result from water leakage in a server room, even if only a small amount of water leaks onto equipment. It is important to have proper monitoring systems and alerts that will notify personnel as soon as possible after any leak occurs. [4]

- Electricity

  Monitoring the state of electricity, including voltage and current, is important in a server room to ensure the stability and reliability of the power supply to the equipment. Electrical voltage and current fluctuations can lead to problems with electronic equipment, such as data loss and corruption. In order to minimize these risks, server rooms are typically equipped with uninterruptible power supplies (UPS) and surge protection devices that help stabilize the voltage. The following list contains some common ranges for voltage and current.[4]

  Voltage: The recommended operating range in from 208V to 240V and the maximum recommended limit is 264V.

  Current: The recommended operating range in from 20A to 40A (per phase)

- Movement

  Movement sensors, also known as motion detectors, can be used in order to detect unauthorized access to the room by detecting movements within the room and alerting the administrators.

1.2 Purpose

The purpose of this thesis is to demonstrate how an effective and efficient monitoring system can be implemented for server rooms using sensors, which are introduced in three categories in the tables 1.1, 1.2 and 1.3. The system will be designed to provide real-time data to a website, so that it can be monitored anywhere with internet access. This thesis will examine how this system was designed and implemented, including the selection of sensors and development of an online panel for monitoring data visualization.

Table 1.1: Electrical sensors

Name	**Measurement Unit**	**Output**
Voltage Sensor	Voltage	ADC
Current Sensor	Amper	ADC

Table 1.2: Environment sensors

Name	**Measurement Unit**	**Operating temp**	**Desired values**
Temperature sensor	Celsius	-20°C - 50°C	18°C - 27°C
Smoke sensor	-	-20°C - 50°C	-
Humidity sensor	Percent	-20°C - 50°C	40% - 60%
Water Leakage Sensor	-	-20°C - 50°C	-
Dust sensor	-	-20°C - 50°C	-

Table 1.3: Security sensors

Name
Movement sensor
Fingerprint sensor
Camera

Chapter 2

Data Generator Selection and Implementation

2.1 Introduction

In this implementation, in order to demonstrate how the monitoring system works instead of using actual sensors, a data generator has been used and it simulates reading of sensors (such as humidity, temperature and electricity).

2.2 Methodology

A data generator should have a random yet realistic pattern for effective system testing, so just using a simple random number would be insufficient. Therefore, in this thesis a controlled version of choosing a random number was used to mimic some parts of real-world criteria and avoid sudden changes. The methodology for this process can be seen in the accompanying flowchart 2.1.

2.3 Results

As discussed in the methodology section, the program was implemented, and the generated values tested with different parameters was saved and reported as line charts in the subsequent sections.

2.3.1 Generated temperature sensor data

- Parameters

  Starting Temperature sensor Value: 22

  Minimum Possible Temperature sensor value: 18

  Maximum Possible Temperature sensor value: 27

  Maximum Possible Change in an iteration: 0.5

- Results can be seen in figure 2.2

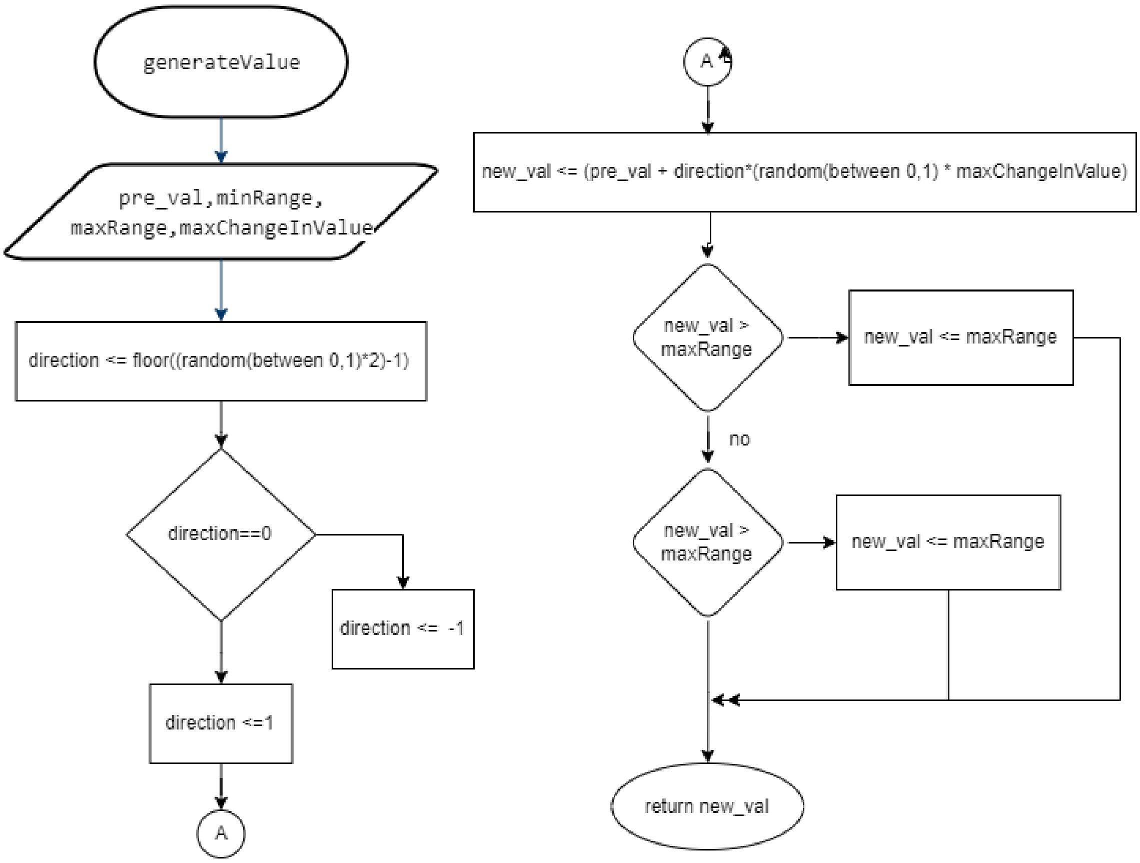
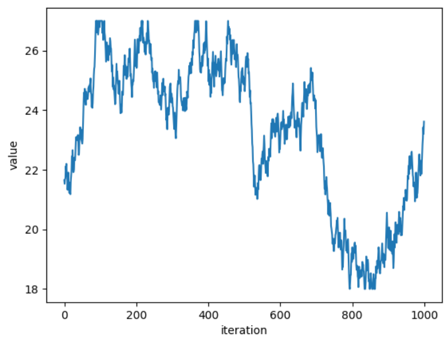
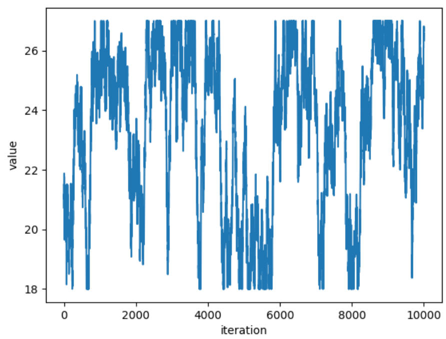


Figure 2.1: Flowchart of data generator

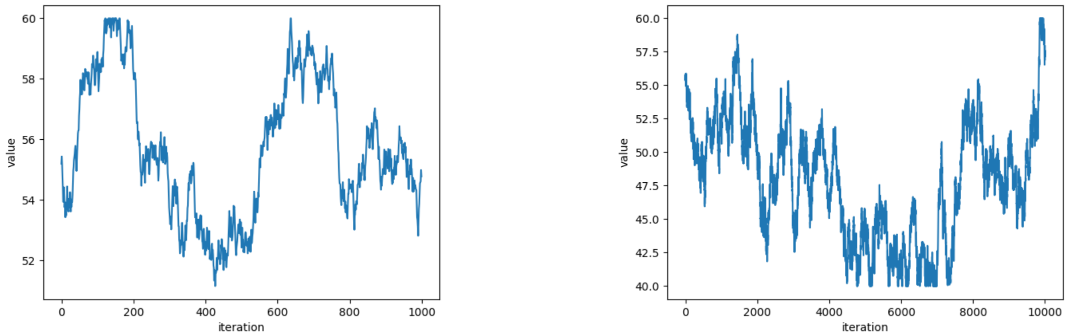


(a) For 1000 iterations



(b) For 10000 iterations

Figure 2.2: Sample generated temperature sensor data



(a) For 1000 iterations

(b) For 10000 iterations

Figure 2.3: Sample generated humidity sensor data

2.3.2 Generated humidity sensor data

- Parameters

  Starting humidity sensor value: 55

  Minimum possible humidity sensor value: 40

  Maximum possible humidity: 60

  Maximum possible Change in an iteration: 0.5

- Results can be seen in figure 2.3

2.3.3 Generated dust sensor data

- Parameters

  Starting dust sensor Value: 220

  Minimum possible dust sensor value: 208

  Maximum possible electricity dust sensor value: 264

  Maximum possible change in an iteration: 1

- Results can be seen in figure 2.4

2.3.4 Generated electricity voltage sensor data

- Parameters

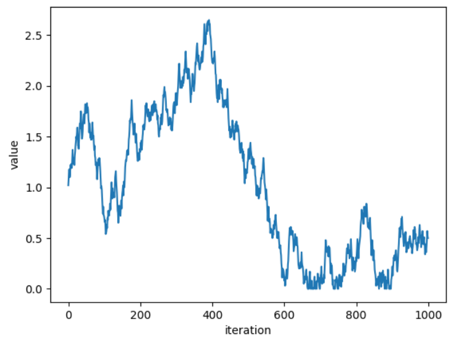
  Starting electricity voltage value: 220

  Minimum possible electricity voltage: 208

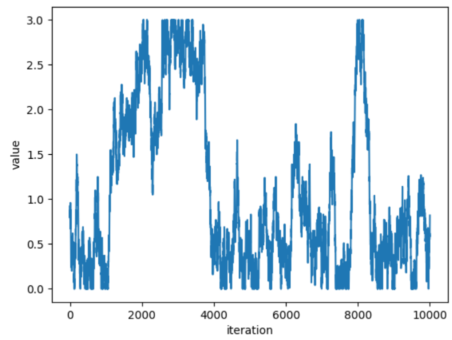
  Maximum possible electricity voltage: 264

  Maximum possible electricity change in an iteration: 1

- Results can be seen in figure 2.6

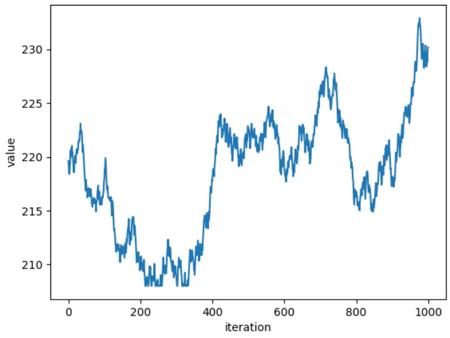


(a) For 1000 iterations

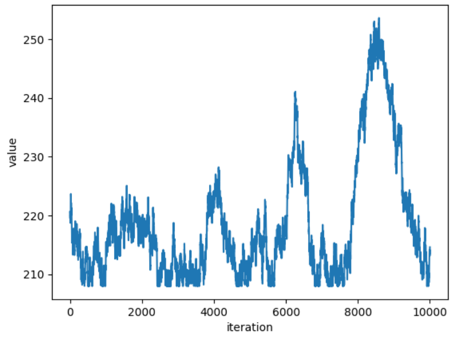


(b) For 10000 iterations

Figure 2.4: Sample generated dust sensor data

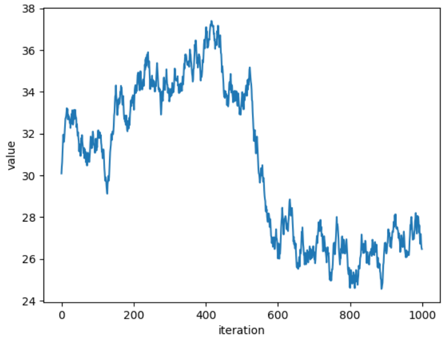


(a) For 1000 iterations

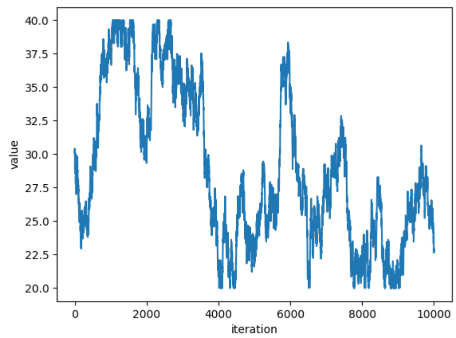


(b) For 10000 iterations

Figure 2.5: Sample generated voltage sensor data



(a) For 1000 iterations



(b) For 10000 iterations

Figure 2.6: Sample generated voltage sensor data

2.3.5 Generated electricity current sensor data

- Parameters

  Starting electricity Current Value: 220

  Minimum possible electricity Current: 208

  Maximum possible electricity Current: 264

  Maximum possible change in an iteration: 1

- Results can be seen in figure 2.6

Chapter 3

Conclusion

conclusion The endmatter

Appendix A

Tables

Bibliography

[1] A. T. C. T. 9.9, "Data center storage equipment thermal guidelines, issues, and best practices." https://resourcecenter.ashrae.org/File%20Library/Technical%20Resources/Bookstore/ASHRAE_Storage_White_Paper_2015.pdf, 2015.

[2] "Data center cooling best practices." https://www.datacenterknowledge.com/data-center-cooling-best-practices/, Feb 2017.

[3] *Effect of Relative Humidity, Temperature and Gaseous and Particulate Contaminations on Information Technology Equipment Reliability*, vol. Volume 1: Thermal Management of *International Electronic Packaging Technical Conference and Exhibition*, 07 2015. V001T09A015.

[4] T. I. Association *et al.*, "Tia-942 telecommunications infrastructure standard for data centers," *Arlington Virginia: Telecommunications Industry Assn*, 2010.